

CLAIMS

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1. A top sealing plate used for a battery, comprising:
a filter, a cap, and a valve body,
- 5 wherein said filter includes a valve hole and upper
opening;
- said cap has a convex portion, and a flange portion
disposed around said convex portion;
- an opening end of said upper opening of said filter has a
10 bend portion;
- an outer periphery end of said flange portion of said cap
and said bend portion include a caulked portion that is
caulked and jointed to each other;
- said caulked portion is formed by caulking while said
15 outer periphery end of said flange is positioned in said bend
portion;
- said valve body is disposed to cover said valve hole, in
a space formed between said cap and said filter;
- said caulked portion includes both contact states of
20 (i) a strong contact portion and (ii) a weak contact portion,
between the surface of the outer periphery end of said flange
and said bend portion; and
- said cap and said flange portion are electrically
connected to each other, by the contact with said outer
25 periphery end and said bend portion at said caulked portion.

2. The top sealing plate of claim 1,
wherein each of said strong contact portion and said weak
contact portion includes a plurality of strong contact
5 portions and a plurality of weak contact portions; and

said plurality of strong contact portions and said
plurality of weak contact portions are disposed along the
circumferential or radial direction of said cap.

10 3. The top sealing plate of claim 1,

wherein said battery comprises a battery case, and a
positive electrode, negative electrode, electrolyte, gasket,
and said top sealing plate disposed in said battery case;

said top sealing plate is disposed at the opening of said
15 battery case so as to close said battery case, in a state of
being electrically insulated by said gasket; and

said filter is electrically connected to said positive
electrode.

20 4. The top sealing plate of claim 3,

wherein said battery is cylindrical in shape;

said battery case has a circular opening;

said top sealing plate is disposed at said opening of
said battery case so as to close said battery case;

25 said cap has a gas vent hole; and

said filter secures said valve body and said cap in predetermined positions.

5. The top sealing plate of claim 1,

5 wherein said outer periphery end of said flange portion includes a projection extending from at least one out of the surface and the back thereof; and

said projection includes at least one selected from the group consisting of a plurality of small projections, bulges,
10 and peripheral edge projected from the surface of said flange.

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6. A top sealing plate used for a battery, comprising:
a filter, a cap, and a valve body,

wherein said filter includes a valve hole and upper
15 opening;

said cap has a convex portion, and a flange portion disposed around said convex portion;

an opening end of said upper opening of said filter has a bend portion;

20 an outer periphery end of said flange portion of said cap and said bend portion include a caulked portion that is caulked and jointed to each other,;

said caulked portion is formed by caulking while said outer periphery end is positioned in said bend portion;

25 said valve body is disposed to cover said valve hole, in

a space formed between said cap and said filter;

a surface of said outer periphery end of said flange has a projection;

said outer periphery end including the plurality of
5 projections and said bend portion are caulked;

said strong contact portion is formed with said projection contacted on said bend portion; and

said cap and said flange portion are electrically connected to each other, by contact between said outer
10 periphery end at the caulked portion and said bend portion.

7. The top sealing plate of claim 6,

wherein said projection includes at least one selected from the group consisting of a plurality of small projections,
15 bulges, and peripheral edge extending from the surface of said outer periphery end.

8. The top sealing plate of claim 6,

wherein said projection includes a plurality of
20 projections; and

the plurality of projections are disposed along the circumferential or radial direction of said cap.

9. The top sealing plate of claim 6,

25 wherein said projection is disposed on the surface of

said outer periphery end of said flange positioned at the same side as said convex portion.

10. The top sealing plate of claim 6,

5 wherein said projection has vertically spring against the contact surface between said flange portion and said bend portion.

11. The top sealing plate of claim 6,

10 wherein said battery comprises a battery case, and a positive electrode, negative electrode, electrolyte, gasket and said top sealing plate disposed in said battery case;

said battery case has a circular opening;

said top sealing plate is disposed at the opening of said
15 battery case, in a state of being electrically insulated by said gasket so as to close said battery; and

said filter is electrically connected to said positive electrode.

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12. A top sealing plate used for a battery, comprising:
a filter, a cap, and a valve body,

wherein said filter includes a valve hole and upper opening;

said cap has a convex portion, and a flange portion
25 disposed around said convex portion;

an opening end of said upper opening of said filter has a bend portion;

an outer periphery end of said flange portion of said cap and said bend portion include a caulked portion that is
5 caulked and jointed to each other,;

said caulked portion is formed by caulking while said outer periphery end is positioned in said bend portion;

said valve body is disposed to cover said valve hole, in a space formed between said cap and said filter;

10 a surface of said outer periphery end of said flange has a projection;

said outer periphery end including said projection and said bend portion are caulked;

said cap and said flange portion are electrically
15 connected to each other, by contact between said outer periphery end at said caulked portion and said bend portion;

the distance from a mating face of said filter and cap to the peak of said projection is greater than the thickness of said flange portion; and

20 each of the peaks has a stronger contact pressure against said bend portion of said filter as compared with zones other than said peaks.

13. The top sealing plate of claim 12,

25 wherein said projection includes at least one selected

from the group consisting of a plurality of small productions, bulges, and projected peripheral edge.

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14. A top sealing plate used for a battery, comprising:
- 5 a filter, a cap, and a valve body,
wherein said filter includes a valve hole and upper opening;
said cap has a convex portion, and a flange portion disposed around said convex portion;
- 10 an opening end of said upper opening of said filter has a bend portion;
an outer periphery end of said flange portion of said cap and said bend portion include a caulked portion that is caulked and jointed to each other,;
- 15 said caulked portion is formed by caulking while said outer periphery end is positioned in said bend portion;
said valve body is disposed to cover said valve hole, in a space formed between said cap and said filter;
- 20 said cap and said flange portion are electrically connected to each other, by contact between said outer periphery end at said caulked portion and said bend portion;
said caulked portion includes an integral projection such that said outer periphery end and said bend portion are integrally projected;
- 25 said integral projection is formed by pressing a

protuberant tool from above the bend portion, in a state that said outer periphery end is positioned in said bend portion; and

said integral projection has a stronger contact pressure
5 as compared with zones other than said integral projection.

15. The top sealing plate of claim 14,

wherein said battery comprises a battery case, and a positive electrode, negative electrode, electrolyte, gasket
10 and said top sealing plate disposed in said battery case; and said battery case has a circular opening;

said top sealing plate is disposed at said opening of said battery case, in a state of being electrically insulated by said gasket so as to close said battery case; and

15 said filter is electrically connected to said positive electrode.

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16. A battery, comprising:

a battery case, a positive electrode, a negative
20 electrode, electrolyte, a gasket, and a top sealing plate,

wherein said positive electrode, said negative electrode, and said electrolyte are disposed in said battery case;

said battery case has an opening;

said top sealing plate is disposed at the opening of said
25 battery case, in a state of being electrically insulated by

said gasket so as to close said battery case;

said filter is electrically connected to said positive electrode;

said top sealing plate comprises a filter, cap, and valve
5 body;

said filter has a valve hole and upper opening;

said cap has a convex portion, and a flange portion disposed around said convex portion;

an opening end of said upper opening of said filter has a
10 bend portion;

an outer periphery end of said flange portion of said cap and said bend portion include a caulked portion that is caulked and joined to each other,;

said caulked portion is formed by caulking while said
15 outer periphery end is positioned in said bend portion;

said valve body is disposed to cover said valve hole, in a space formed between said cap and said filter;

said caulked portion includes both states of contact of (i) a strong contact portion and (ii) a weak contact portion,
20 between the surface of the outer periphery end of said flange and said bend portion; and

said cap and said flange portion are electrically connected to each other, due to contact established between said outer periphery end and said bend portion at said
25 caulked portion.

17. The battery of claim 16,
wherein said outer periphery end of said flange portion
includes a projection extending from at least one out of the
5 surface and the back thereof;

said projection includes at least one selected from the
group consisting of a plurality of small projections, bulges,
and projected peripheral edge;

said strong contact portion is formed by said projection
10 and said bend portion contacting with each other; and

said weak contact portion is formed by zones other than
said projection and said bend portion contacting with each
other.

15 18. The battery of claim 16,

wherein each of said strong contact portion and weak
contact portion includes a plurality of strong contact
portions and a plurality of weak contact portions; and

the plurality of strong contact portions and the
20 plurality of weak contact portions are disposed along the
circumferential or radial direction of said cap.

19. The battery of claim 17,

wherein the plurality of projections are disposed on the
25 surface of said outer periphery end of said flange positioned

at the same side as said convex portion.

20. The battery of claim 17,

wherein said projection has vertically spring against the
5 contact surface between said flange portion and said bend
portion.

21. The battery of claim 17,

wherein the distance from the mating face of said filter
10 and cap to the peaks of said plurality of projections is
greater than the thickness of said flange portion; and

each of said peaks has a stronger contact pressure
against said bend portion of said filter as compared with
zones other than said peaks.

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22. The battery of claim 17,

said caulked portion includes an integral projection such
that said outer periphery end and said bend portion are
integrally projected;

20 said integral projection is formed by pressing a
protuberant tool from above the bend portion, in a state
that said outer periphery end is positioned in said bend
portion; and

said integral projection has a stronger contact pressure
25 as compared with zones other than said integral projection.

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23. A method of manufacturing a battery, comprising the steps of:

(a) disposing a positive electrode, a negative electrode,
5 and electrolyte in a battery case;

(b) manufacturing a top sealing plate;

(c) electrically connecting said filter and said positive electrode; and

(d) disposing said top sealing plate at the opening of
10 said battery case via an electrical insulating gasket in order to close the opening,

wherein the step of manufacturing said top sealing plate comprises the steps of:

(1) forming a filter having a valve hole and upper
15 opening;

(2) bending the opening end of the upper opening of said filter, to form a bend portion;

(3) forming a cap having a convex portion and a flange portion disposed around said convex portion;

20 (4) caulking to join the outer periphery end to said bend portion while the surface and back of the outer periphery end of said flange portion of said cap are positioned in said bend portion, to form a caulked portion; and

(5) disposing a valve body serving to cover the valve
25 hole in a space formed between said cap and said filter, and

whetrein the step of forming said caulked portion includes a step of electrically connecting said cap and said flange portion to each other by contacting the outer ^{A₁₂}periphery end at said caulked portion with said bend portion so that said caulked portion includes both states of contact of (i) a strong contact portion and (ii) a weak contact portion, between the surface of the outer periphery end of said flange and said bend portion.

10 24. The method of manufacturing a battery of claim 23, wherein the step of forming said cap includes a step of forming a projection extending from at least one out of the surface and the back at the outer periphery end of said flange portion;

15 said projection includes at least one selected from the group consisting of a plurality of small projections, bulges, and projected peripheral edge;

said strong contact portion is formed by said projection and said bend portion contacting with each other; and

20 said weak contact portion is formed by zones other than said projection and said bend portion contacting with each other.

25 25. The method of manufacturing a battery of claim 23, wherein each of said strong contact portion and weak

contact portion includes a plurality of strong contact portions and a plurality of weak contact portions; and

the plurality of strong contact portions and the plurality of weak contact portions are disposed along the
5 circumferential or radial direction of said cap.

26. The method of manufacturing a battery of claim 24,
wherein said projections are disposed on the surface of
the outer periphery end of said flange positioned at the same
10 side as said convex portion.

27. The method of manufacturing a battery of claim 24,
wherein said projection has vertically spring against the
contact surface between said flange portion and said bend
15 portion.

28. The method of manufacturing a battery of claim 24,
wherein the distance from the mating face of said filter
and cap to the peak of said projection is greater than the
20 thickness of said flange portion; and

each of said peaks has a stronger contact pressure
against said bend portion of said filter as compared with
zones other than said peaks.

25 29. The method of manufacturing a battery of claim 23,

wherein the step of forming said caulked portion includes a step of forming an integral projection at said outer periphery end and said bend portion, by pressing a protuberant tool from above the bend portion while the
5 surface and back of said flange portion of said cap are positioned in said bend portion; and

said integral projection has a stronger contact pressure as compared with zones other than the integral projection.

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